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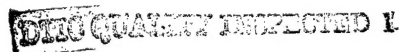
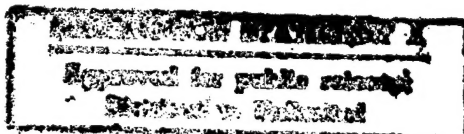
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Per your request is a copy of our Year-2000 paper in MS Word prepared and released under Distribution List "A" by the Director of T&E Coporate Information management in late 1996.

Regards,

George

P.S. Please acknowledge successful receipt.

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TEST AND EVALUATION YEAR-2000 TEAM REPORT

to the

Test and Evaluation Board of Operating Directors

September 30, 1996

Foreword

We express our sincere thanks to the T&E Year 2000 team members who prepared this report. They provided a valuable service to the DoD community by helping scope a potentially serious problem with widely varying characteristics and effects. Their donated time for the Year 2000 study came in addition to normal duties. The assessments and reference material in this report forms the foundation for all T&E Year 2000 efforts to come.

The T&E Year 2000 Team:

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Thanks for your outstanding support!

Director, T&E Corporate Information Management

TEST AND EVALUATION YEAR-2000 TEAM REPORT

to the
Test and Evaluation Board of Operating Directors
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TEST AND EVALUATION YEAR-2000 TEAM REPORT

to the

Test and Evaluation Board of Operating Directors

July 10, 1996

EXECUTIVE SUMMARY: The Test and Evaluation (T&E) Board of Operating Directors (BoOD) commissioned a T&E Year-2000 Team in March 1996 to assess the vulnerability of the T&E community to Year 2000 problems and their impact within the Department of Defense (DoD) T&E community. These problems are those which will affect computer based systems at or near the transition to the year 2000. These problems can lead to possible year misrepresentation internal to computers, their associated programs and their related data stores. The T&E Year-2000 Team focused on case studies within the Major Range and Test Facility Base (MRTFB) to extrapolate an assessment of the overall Year 2000 issue as it pertains to T&E. The team also surveyed parallel DoD efforts and commercial support available to resolve Year 2000 issues. The team discovered that the T&E community was vulnerable in subtle ways to the Year 2000 issue. We learned that many major scientific and engineering computer applications were exempt by merit of the state of the art environment in which they run or the nature of the applications themselves. While many of these primary applications may well be Year 2000 compliant, the related subsystems, utilities, feeders and management systems upon which they depend are not. Thus, where they exist, Year 2000 problems in the T&E community are deep seated, rooted in subtle interfaces and not patently evident. Prevailing commercial practices recommend an end-to-end review of all existing code for potential Year 2000 problems. Often, however, the necessary code parsing tools are unavailable or, when available, require costly expertise to run. Moreover, the original source code may no longer be available in many significant cases. For these reasons, the T&E Year-2000 Team recommends a methodology whereby the actual data artifacts from T&E systems be analyzed for instances of Year 2000 problems when the actual code is unavailable. This can be most economically accomplished by a central T&E "Year-2000 Clearing House" which would impartially screen data submitted by T&E installations. The resulting annotated data maps and/or code reviews would then be shared with the affected installations for Year 2000 problem prioritization and repair. A significant side benefit is that data maps, when created, also serve as substantive analytical tools for broader enterprise re-engineering initiatives. Once the high priority code is corrected at the installation level, subsequent testing would be performed by the T&E "Year-2000 Clearing House". This approach minimizes the number of knowledgeable tool practitioners and reduces the overall cost and effort necessitated by data analysis and code parsing at the local level. Moreover, as the T&E "Year-2000 Clearing House" gains proficiency, it can offer its services to other DoD elements and thus, potentially reimburse or exceed the initial investment necessary to get it operationally proficient. The team also strongly recommends a program urgently aimed at heightened awareness of the importance of this problem.

TEST AND EVALUATION YEAR-2000 TEAM REPORT

to the

Test and Evaluation Board of Operating Directors

July 10, 1996

SECTION 1: POTENTIAL YEAR 2000 PROBLEMS: There is a real risk that automated systems, including software applications, will yield inaccurate results at or near the century change. This problem manifests itself when the year becomes 2000, and, in some special cases, 1999. For example, the Global Positioning System (GPS) has a date related error in its receiver technology which, if not corrected in all GPS receivers, will invalidate GPS positioning data after August 1999. Business systems, heavily dependent on dates to control their processing, if not fully corrected for Year 2000 faults, could create massive disruptions in fundamental business areas upon which T&E depends. Functions such as payroll, accounts payable, accounts receivable, human resources management and procurement could be seriously affected. Additionally, T&E support systems such as scheduling tools, maintenance tracking systems and base operations support systems are vulnerable to Year 2000 deficiencies. The T&E community itself may be vulnerable to unforeseen disruptions in scheduling operations such as real-time weapon system testing, range and flight safety systems, and time critical data processing. For example, simple year related failures in older T&E data systems could interrupt operations or even affect availability of primary test capabilities, automated target tracking systems, telemetry systems, T&E based computational systems and vendor provided technical software. Such failures could also lead to the disruption of data archival systems related to the storage of T&E data.

The full extent of the potential Year 2000 problem is non-trivial. Put into DoD-wide perspective, the repair effort appears overwhelming. The overall project in the DoD community requires an incredible level of coordination and tracking to ensure success. The technical issues to both business and scientific computing are important, but small in contrast to the project management issues. At the detail level, conversion activities (hardware, software, and firmware) are routine and definable. They make up the greatest portion of the effort; however, once defined, assigned, prioritized, and managed they can proceed simply and effectively. Contrary to initial perceptions, century compliance is primarily an exercise in large-scale project management.

The Assistant Secretary of Defense for Command, Control, Communications and Intelligence (ASD(C3I)) has formally notified all of the Department of Defense (DoD) of the impending and very real danger. As noted, the full range of business and base support systems are in real jeopardy of malfunctioning at or before the year 2000. The size of the T&E systems' Year 2000 problem appears somewhat more scalable, although the full extent of the situation is not yet defined. Accordingly, the Director for Test, Systems Engineering and Evaluation (DTSE&E) in the DoD Office of the Secretary of Defense (OSD) directed an assessment of the Year 2000 problem as it affects T&E. Responsively, the Joint Program Office for T&E (JPO(T&E)) proposed and the T&E Board of Operating Directors (BoOD) commissioned a T&E Year-2000 Team to undertake an assessment of the problem in the T&E community. Pertinent correspondence and the text of the proposal for a 90 day study effort may be found at Appendix A. The study methodology adopted by the team is at Appendix B.

A. VULNERABILITIES: The "Year-2000 Problem" is actually a combination of several component vulnerabilities related to transition to the year 2000.

1. TWO CHARACTER YEAR REPRESENTATION: The largest and best known class of "Year-2000 Problems" involves the use of two digit fields to represent the year. In less technically sophisticated times when computer storage was at a premium, such two byte year representation was a common convention to conserve space. The characterization of this phenomena appears when two numeric or alphabetic characters are used as a variable data element to represent the year only to the decade level. In these cases, the century is assumed to be a "19". In some cases, the "19" may actually have been hard coded. Often, the two digit year characters are embedded in a larger date field. For example, a representation of MM/DD/YY places the two character year at the end of the larger date string. In other cases, such embedded dates are more subtle. Examples where strings of data may impart year intelligence include contract numbers, invoice record numbers or Job Order Number (JON) where the year is embedded as a two character portion of the larger number. In all these cases, the assumption that the century is "19" will convey into the year 2000, resulting in incorrect date and day of the week representation in all resulting instances of date information beyond the transition.

2. RESERVED CHARACTERS IN YEAR FIELDS: A related problem involves the use of the characters "99" and "00" in year fields. Often these numbers are reserved in year fields to denote special conditions that affect the computer program operating on this field. For example, the date string 9/9/99 is often assigned by convention to mean "unlimited" or "unconstrained" date data is to be used. The string of "99" in the year field may also indicate such things as default values, the last record in a series of input records or a "null" value. In such cases system "rollovers" on January 1, 1999 can trigger specific misrepresentations of year data to occur a full year ahead of the year 2000. Likewise, use of "00" in the year field may indicate a null record or denote an interrupt vector. In such cases, many applications run in 1999 will be against transactions for the year 2000. In both instances any system which forecasts transactions by date are in jeopardy.

3. DATE-IN-KEY: Another issue involves data input. The "date-in-key" problem involves the use of interactive screens to capture date information. Even if the year is internally represented as four digit century data, the on-line capture field may use the two digit representation to conserve valuable screen "real-estate". In such cases, programmatic resolution will be required to reconcile the century level year differentiation. The software language vendor should be contacted to ascertain a solution to this problem.

4. LEAP YEAR CALIBRATION: The Leap year issue is even more subtle. A specific year is a leap year if it is evenly divisible by 400 OR evenly divisible by 4 and not evenly divisible by 100. Thus, the year 1900 was not a leap year but the year 2000 is. Some potential exposures caused by the identification of the year 2000 as a non-leap year are:

- day-in-year calculations. The year 2000 has 366 days; not 365.

- day-of-the-week calculations. February 28, 2000 is a Monday and 1 March is a Wednesday, not a Tuesday which is February 29, 2000.

- week-of-the-year calculations. The 11th week of the year 2000 is 5 through 11 March, not 6 through 12 March.

If the programs that manipulate date information are not properly calibrated for this special once every 400 year case, date representation will be amiss after the leap year is in effect.

5. DAY CLOCK: The "Day-Clock Problem" involves an even deeper abstraction. Some operating systems (software) are built such that the default date will revert to something other than the actual date when the century rolls to 2000. In such cases, depending on the operating system, dates may or may not be represented correctly, but file storage schemes will be inaccurate. Most existing DOS BIOS implementations (hardware) also have such problems. Thus, many personal computers (PC) have design susceptibility to this fault. Their Real Time Clock (RTC) chips (a hardware component) keep dates as "century/two-digit year/month/day" but their DOS (operating system - a software component) date is kept as "days-since-1980/01/01". On January 1, 2000 the RTC will roll 99 (two digit year) to 00 but the century remains at 19, so, we have 19/00/01/01 and the date 01,01,2000 effectively becomes 01,01,1900. Seemingly, DOS correctly handles the change making any date APPEAR correct to the computer user. The result, however, is an internal date conflict which the computer date conversion algorithm attempts to resolve by calculating an erroneous date such as 1980-01-04 or 01/01/:0. Users will be unaware of the problem until they reboot and attempt to access a file with the erroneous storage/creation date. Over time, all files created after the century roll over will have that same erroneous creation date. Access to the "real" file may not be available or out of sequence. Other instances of this problem could have devastating results on archival or backup data labeling. (Note that many PCs manufactured since mid-1995 are Year 2000 compliant and others contain a programmable BIOS chip that can be upgraded by diskette).

6. LICENSE EXPIRATION: Most insidiously, commercial software offerings containing an embedded license expiration date may go dead at the year 2000 rollover. Worse, if the license code is definitive, affected commercial software will be "turned-off" permanently when it "sees" a year of "00". This could happen even when only experimenting to see if the Year 2000 problem exists within other components of the computer system.

B. IMPACTS: These vulnerabilities are compounded by a number of practical considerations.

1. EXTENT OF THE PROBLEM: The Year 2000 problem is pervasive and has a well known deadline. It particularly extends to aged legacy systems. In such cases, the source code that produces the undesirable Year 2000 results may well be unavailable, unreadable, impossible to recompile, undocumented or legally inaccessible because of contractual "ownership" issues. In other cases, Year 2000 compliant systems are negatively affected by input data from other non-compliant systems. In fact, studies reveal the majority of Year 2000 problems will manifest themselves at the interface level. Often this problem is aggravated by less obviously involved

embedded software in systems and subsystems. The rapid growth of electronic communications systems also tend to propagate and worsen this potentially serious phenomena.

2. HIDDEN NATURE OF THE PROBLEM: The manipulation of date information can often be hard to discover. Date manipulations may span hundreds of lines of code within a given application. In some instances, these manipulations can occur across related programs or within or among supporting utilities. Often, year manipulations are embedded in controllers, firmware based micro-code, operating systems, real-time clocks and other less than obvious system level resources. Thus, even if the application has no apparent date manipulation algorithms, it still may not be exempt from one of the Year 2000 related problems. A simple example of this phenomena is a subroutine that date stamps the header information in archival tapes regardless of the rest of the content.

3. TESTING THE PROBLEM: Testing for Year 2000 compliance yields other problems. Even if a single application is compliant, its testing must be synchronized with companion applications which may pass date information to assure the overall system of applications is safe to run. This problem is non-trivial. Worse, large production systems cannot be shut down for testing. Even where possible, testing with the year 2000 change can create unexpected havoc among existing production data. In most cases, setting up a parallel system for tests is utterly prohibitive by cost or practical considerations.

SECTION 2: T&E YEAR-2000 TEAM FINDINGS: The following section details T&E Year-2000 Team findings from the initial case study approach:

A. **INTERVIEW RESULTS:** The specific results of the focused team interviews may be found at Appendix C. The Year 2000 problem is not trivial within T&E, but may not be as widespread as initially feared within primary applications employed by the T&E community. The outward appearances are that a large number of primary functional applications are totally exempt from Year 2000 related problems. The hidden component of the Year 2000 issue, however, still exists beyond and beneath the obvious functional considerations found at the applications level. The Year 2000 transition problems definitely affect significant portions of the business, scientific and desktop systems within the entire T&E community. The real issue is that these problems, where they exist, are insidious and not self-evident by the casual observer or even the dedicated user. The interviews indicated that most managers were willing to learn more about the Year 2000 problem and take necessary actions. There was, however, a subtle undercurrent of denial in the sense that the problems were attributed to "someone else", such as vendors or program creators, or that the problem was not immediately observable, so therefore must be trivial.

1. **BUSINESS SYSTEMS:** Business systems are clearly the most susceptible to serious Year 2000 problems at MRTFB sites. Many business systems and corporate information systems at the ranges, however, run under modern database management systems (DBMS) such as Oracle and its tools. Systems running under such DBMS are considered "safe" in so far that these tools force four place date fields within the databases themselves. Most "major" business systems have been or will soon be converted in the Navy and Air Force sites studied. The Army, however, still employs mainframes running a significant number of Common Business Oriented Language (COBOL) programs and earlier vintage databases. These applications are highly suspect in terms of potentially undesirable Year 2000 instances. Additionally, all remaining legacy business systems, small localized feeder systems, and unconverted middle-ware supporting major systems at all sites are in the most jeopardy of creating major Year 2000 problems at the T&E sites. Feeds from externally managed Central Design Agent (CDA) systems and other external feeder systems regardless of size which are not corrected for the year 2000 pose a significant, but presently not yet fully dimensioned, risk throughout the business data processing community within T&E. As has been reported by industrial Year 2000 practitioners, the primary Year 2000 problems are at the interfaces between related systems. Thus, while primary systems may well be "date safe", the integrated operations they support may well be highly vulnerable to Year 2000 failures.

2. **SCIENTIFIC SYSTEMS:** Scientific systems appear by the testimony of their managers to be less vulnerable to outright Year 2000 problems. While their specific "face-value" Year 2000 vulnerabilities appear to be less widespread, the threats are far more subtle in nature where they do exist. Most scientific applications deal substantively with the passage of time and the precise measurement of elapsed time in a relative sense, but few involve time calculations which include dates or years. Such "date free" systems are exempt from Year 2000 problems by all apparent functional measures. Some specific areas of vulnerability, however, appear to lend themselves to a higher probability of Year 2000 occurrences within the T&E scientific computing community.

Initial reaction among the T&E engineers, computer scientists, and technicians interviewed was vague awareness of the Year 2000 issue and an expression that its impact on their systems was minimal to none. Only one of those interviewed, however, had a complete inventory of his division's computer hardware and software applications. Most functional computer applications in T&E are primarily concerned with operating complex scientific instrumentation systems which gather, analyze, and store test data. As noted above, these systems deal with data and time measurements on the order of milliseconds and microseconds. The year is typically not a factor in these measurements. This fact caused these T&E professionals to dismiss the Year 2000 problem as having no impact on their systems. Further discussions with them about specific instances of the use of date information in their system's computer software revealed potential impacts which they had not considered. These potential impacts arose from the operating system supporting their instrumentation system's application software and from subprograms (such as calibration and data recording/reporting) associated with the main application software. Extensive off line testing would be needed to gauge the true extent of these type of date problems.

Year 2000 concerns often lie embedded in older hardware and/or firmware in scientific systems making them harder to detect and potentially insidious as they tend to act as "time bombs". The Joint Test Assets Database (JTAD) produced a large list of Patuxent River-based laboratories each of which most likely contain one or more computational assets. The Patuxent River inventory system identified a heterogeneous list of computers operating within the site's laboratories. These lists reveal that many applications are running under a wide variety of operating systems. Large scale Time Space Position Information (TSPI) systems such as IRIG-based tools or the Global Positioning System (GPS) and its calibration ephemeris pose a potential, but not as of yet dimensioned, concern. Command, Control and Communications systems, including localized data links and Systems Under Test (SUT), may contain latent Year 2000 embedded design susceptibilities and require further research. Sub-systems that place labeling and header information on storage media may also exhibit year related problems after year 2000.

Tests conducted on two radar systems revealed that these computers' operating systems would not accept year 2000 dates as valid and one would not "boot up". If the radar computer won't boot then the application software will not load. The operating system in this case is approximately 8 years old; however, it is supported by the manufacturer under a maintenance contract. This manufacturer was unaware of the Year 2000 problem but affirmed that it would investigate solutions/cost to fix. The fix could be as simple as installation of the latest version of the operating system. The isolation and resolution of similar deficiencies within T&E systems awaits further analysis across the T&E community.

Some instrumentation systems on one range utilize "star calibration" to perform system level calibrations. This is typically a subprogram of the main application program and involves input of a date to determine a reference or fix of the star position in relation to the instrumentation system. Testing has not been done to determine Year 2000 impact. The instrumentation system's manufacturer has been queried but no new information arising from this was available at the time of this report.

Much test/calibration equipment that is used to maintain these complex instrumentation systems utilize microprocessors and software to function. Tests have shown that the century change will impact this equipment. While some of these computers are scheduled for replacement before 2000, several affected systems are not slated for replacement.

Scientific data processing is directly and indirectly dependent on business systems, planning systems, scheduling systems and other "mundane" large to intermediate sized utilities for smooth functioning and logistics. To this extent the scientific computing community is vulnerable to and has a direct stake in the Year 2000 problem. Feeds from external systems not corrected for the year 2000 pose a potentially substantial risk throughout the T&E scientific data processing community so far as these systems contain embedded two digit date information which is or may be subsequently used in further calculations.

3. DESKTOP SYSTEMS: Many personal computers (PC) contain embedded Operating System and DOS BIOS Year 2000 related design faults. These concerns can range from complete devastation to mild inconvenience based on how they are embodied and how the systems are employed by their users. For example, the Naval Air Warfare Center - Patuxent River, Maryland has some 8,000 PCs and 700 MACs (Macintosh computers' operating systems are Year 2000 compliant and do not exhibit Year 2000 problems) listed on the Division-wide inventory. The consequence to localized and base-wide electronic mail and data exchange capabilities, based largely on personal computer technology are not yet assessed. There are no known additional funds available to seek, isolate and resolve such Year 2000 issues. There is, however, a sense among those interviewed that the rate of turnover among PCs will replace presently vulnerable systems with Year 2000 compliant systems within ample time. Moreover, there is a known, free "fix" to the PC Year 2000 problem available to users of the World Wide Web. An explanation of the Year 2000 problem on PCs, a compliance test, and the WEB page address for the "fix" can be found at Appendix D. For these reasons, no costs have been attributed to T&E for correcting Year 2000 problems for PCs in this report. The onus will be on users who retain their existing Year 2000-flawed computers into the next century to adopt the correction.

B. COST ASSESSMENT FOR T&E YEAR 2000 REMEDY: For the purpose of discussing costs associated with eliminating the Year 2000 problem from the T&E community, computer assets were divided into three broad categories: pure T&E computer assets, ancillary (base operations, range scheduling, program management, etc.), and functional dependencies (information systems in finance, supply, etc.). The pure T&E computer assets are further subdivided into mainframes, workstations, servers and desktops. As noted above, no costs are reflected in this report for desktops.

1. T&E COMPUTER ASSETS: Testimony from T&E managers and engineers at the three sites, and the T&E Year-2000 Team's own research and analysis leads to the conclusion that all three sites experience almost exactly the same circumstance regarding Year 2000 as an issue. Generally, the scientific and engineering applications that operate on pure T&E computer assets were not found to be adversely affected in and of themselves by Year 2000 problems. This stems from the simple fact that these applications do not use dates in their operation. This assessment could not be verified by actual physical examination of representative code or data, but was

affirmed in nearly every interview. Costs will be incurred, however, to identify and replace hardware and certain support software that are not inherently Year 2000 compliant by design. In instances where the hardware's operating system (OS) is not Year 2000 compliant, either the OS will have to be upgraded or the hardware replaced (some Original Equipment Manufacturers (OEMs) do not offer replacement Year 2000 compliant OSs for some computer models). In these cases, the engineering applications, while Year 2000 compliant themselves, will probably need to be modified to operate in the new Year 2000 compliant environments. The T&E Year-2000 Team derived the figures below from interview statements, inventory lists where they were available and by gross estimations. In some cases numbers were provided only as rough approximations and are, therefore, not considered official

a). Naval Air Warfare Center, Patuxent River: Patuxent River NAS should be commended for their proactive approach to the Year 2000 problem. A significant program is underway there and detailed data was available to assist with the T&E Year 2000 team's analysis. The following tables reflect the number of pure T&E computing assets at Patuxent River and estimated costs to convert systems to Year 2000 compliance.

Patuxent River, MD T&E Computer Assets

<u>Computer Type</u>	<u>Competency Type</u>	<u>Number</u>	<u>Total</u>
Mainframes/Minis	T&E	34	59
	Engineering	25	
Workstations	T&E	115	190
	Engineering	75	
Servers	T&E	85	140
	Engineering	55	
<u>Total</u>			<u>389</u>

Of these 389 systems it can be assumed that approximately 1/3 are or will be Year 2000 compliant because they receive normal upgrades from annual maintenance agreements with the OEM or third party provider; 1/3 are scheduled for replacement before 2000 so no Year 2000 additional cost will incur, and 1/3 (130) must be upgraded. Costs to upgrade such computers are divided into two categories: systems that are still running the original OS thus requiring many layers of new software through the model series (or complete system replacement depending on the economics and time constraints of each situation), and systems that need only the latest OS. The team assumed that half of these computers will fall into each category (65 each) and that costs to replace all the OS-series software or completely replace the system (hardware/software) are, on average, relatively the same. Attendant application software modification costs are also approximated by rule-of-thumb as equal to the hardware/OS replacement cost.

1) Total OS Line or Entire Hardware System Replacement:

$$65 \times \$20,000 = \$1,300,000$$

2) Latest OS Replacement:

$$65 \times \$3500 = \underline{\$227,000}$$

3) Subtotal \$1,527,000

4) Application Software Modifications:

$$\underline{\$1,527,000}$$

5) Total Patuxent River, MD T&E Costs:

$$\$3,054,000$$

The FIGURE 1 Pie Chart below illustrates Year 2000 cost distribution for this T&E Activity.

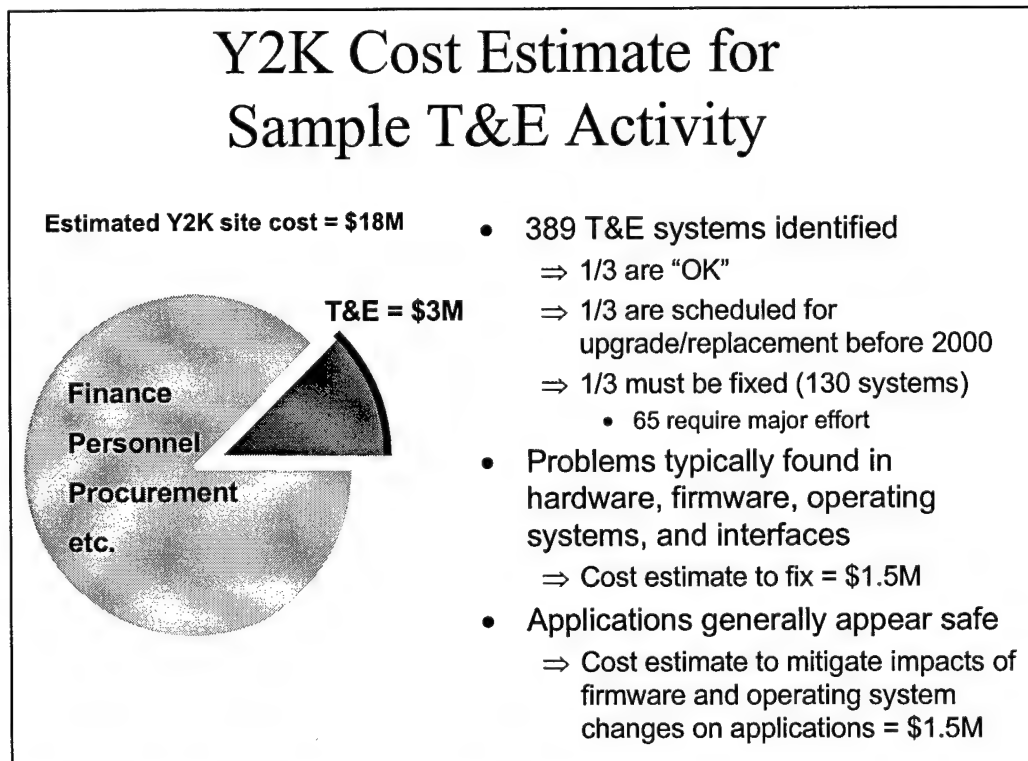


FIGURE 1

b). Aberdeen Test Center, Aberdeen , MD: Year 2000 transition costs at Aberdeen Proving Grounds for pure T&E assets are indicated to be significantly less than the Patuxent River, MD estimate. Here costs for Year 2000 range from \$0 to \$300,000 according to the information made available during interviews.

Aberdeen, MD Year 2000 Estimated T&E Costs:

\$ 309,000

c). Air Force Flight Test Center (AFFTC), Edwards AFB, CA: The primary engineering/range support systems located at the AFFTC have been either replaced or upgraded within the last two years. It is believed that the hardware/software/operating systems currently being used are century aware and will not suffer significant problems. Other range instruments such as radar systems, cine-theodolites, etc., are also planned for upgrade, replacement or to be mothballed prior to the year 2000. The overall feeling was that the year 2000 will only bring a minor impact to the range/engineering systems. The major AFFTC business systems that are expected to continue beyond 2000 are believed to be century aware and also will not suffer significant failures. It is anticipated that costs for infrastructure and ancillary system failures may range from \$0 to \$200,000.

AFFTC, Edwards AFB, CA Year 2000 Estimated T&E Costs

\$ 200,000

2. ANCILLARY AND FUNCTIONAL COMPUTER ASSETS: These systems are generally developed and maintained by each major organization's information management support function to support the entire activity or Command. The Naval Air Warfare Center Aircraft Division, Patuxent River, MD's and Aberdeen, MD's estimates below represent overall functional costs encompassing activities outside those range sites, whereas the estimate for AFFTC reflects only for Edwards AFB, not the needs of the Air Force Material Command. Each site has examined its information, management, base support, and range support systems with regard to Year 2000 impacts. The following estimates reflect the costs to repair or replace that software and affected hardware platforms, anticipating that some system components will fail plus the cost to do some level of situational testing.

Naval Air Warfare Center Aircraft Division Estimated Business System Year 2000 Costs:

\$15,000,000

Aberdeen Proving Ground Garrison Estimated Business System Year 2000 Costs:

\$ 6,000,000

AFFTC, Edwards AFB Estimated Business System Year 2000 Costs:

\$ 200,000

3. GENERALIZATION TO THE MRTFB COMMUNITY: The wide variance in these honestly derived Year 2000 compliance costs makes the T&E generalization question most difficult to answer. A rough average of all costs defined in this survey comes to \$8,254,000 per site to correct scientific and business systems for Year 2000 problems. Applied across all MRTFB sites, the total estimate for achieving nominal Year 2000 compliance exceeds \$150,000,000. This figure, while in keeping with T&E's share of larger DoD estimates, however, is largely a best guess. The estimates from the sites studied were not rigorously developed based on detailed fact. Their wide range further adds to the uncertainty. Moreover, the costs to identify the true extent of the problem were not really calculated into the estimates provided. Thus, the estimates do not reflect the discovery cost to perform inventories, triage "at-risk" systems and interfaces and establish solid configuration management practices where required. Given these factors, combined with the need to impress on management that the real problem may not meet the eye, the loosely derived estimate may well prove to be precipitously low. The perplexing problem is that to produce a serious Year 2000 business case requires a significantly detailed assessment of the real Year 2000 impact across all MRTFB installations. This effort in and of itself could easily cost more than \$15,000,000 based on the best available industry estimates of 10% of the total estimated implementation cost.

C. INDUSTRY TRENDS: T&E Year-2000 Team participants conducted a detailed literature search of commercial enterprises offering Year 2000 solutions. Much of this literature was available via the World Wide Web (WWW). The Test and Evaluation Community Network (TECNET) Home Page contains a growing number of significant DoD related Year 2000 references. This page is <http://tecnet1.jcte.jcs.mil:8000/>. A number of team participants also attended key Year 2000 conferences and public Federal meetings where additional commercial information and Year 2000 insights became available. From these meetings, the team identified two innovative industry leaders to evaluate via direct interaction. These organizations included: OAO Corporation which possessed an omnibus task order from the General Services Administration (GSA) and DBSTAR which offered a unique, but unproved data oriented approach to Year 2000 assessment. Appendix E contains a tabular compilation of significant Year 2000 commercial offerings as compiled by the T&E Year-2000 Team.

1. The clear mandate within the recommended industrial trends was to perform a detailed assessment of all existing code. The most recommended procedure was to literally parse all of the code for instances of Year 2000 year manipulations that could create serious misrepresentation problems. This practice goes well beyond a mere inventory of code. (which is a necessary first step). Rather it requires that this code be analyzed in great detail. Several vendors and private organizations experienced in Year 2000 problem solving reported that attempts to analyze code for date instances by human examination only meet with limited success. Such experiences demonstrate that separate groups of analysts and programmers all examining the same code will invariably find different sets of instances. Both data elements and data values that appear to represent dates to one group may not be at all apparent to another.

This is due to the so-called "creative" nature of coding without standards. Clearly, tools are needed. A number of powerful code parsing tools exist for this purpose. These tools generally evaluate the code from the standpoints of: Calls to the Operating System, Date formats, Variables containing dates, Buffers, and Year defaults. However, most of these parsers are largely aimed at mainframe computers running a large complement of COBOL programs. The more diverse the language base used, as is the case in T&E, the greater the odds that suitable parsers are unavailable, much less the necessary compilers. Thus, T&E investment in parsers and the knowledge to run, or worse yet, create them could be great. The cost of such analysis is estimated at \$35,000 per 1,000,000 lines of COBOL code, assuming a homogeneous code base. OAO, the General Services Administration's (GSA) Year 2000 vendor, estimates this initial assessment effort consumes about 10% of the necessary work to eradicate the Year 2000 problem.

2. Another 15% of the Year 2000 effort, according to OAO, involves assessing and testing tools for repairing and testing for compliance once the original diagnostics have been performed. Assuming the completed diagnostics and a reasonable tool set, the next 10% of effort involves planning with confidence for code correction, testing and implementation. This last phase consumes some 65% of the overall effort. These estimates were supplied by OAO Corporation, which is the firm selected by GSA to support and help coordinate Year 2000 activities throughout the Federal Government. These percentages are illustrated in the FIGURE 2 Pie Chart. FIGURE 3 applies the OAO model to the estimated Year 2000 T&E costs (Business and Scientific computing).

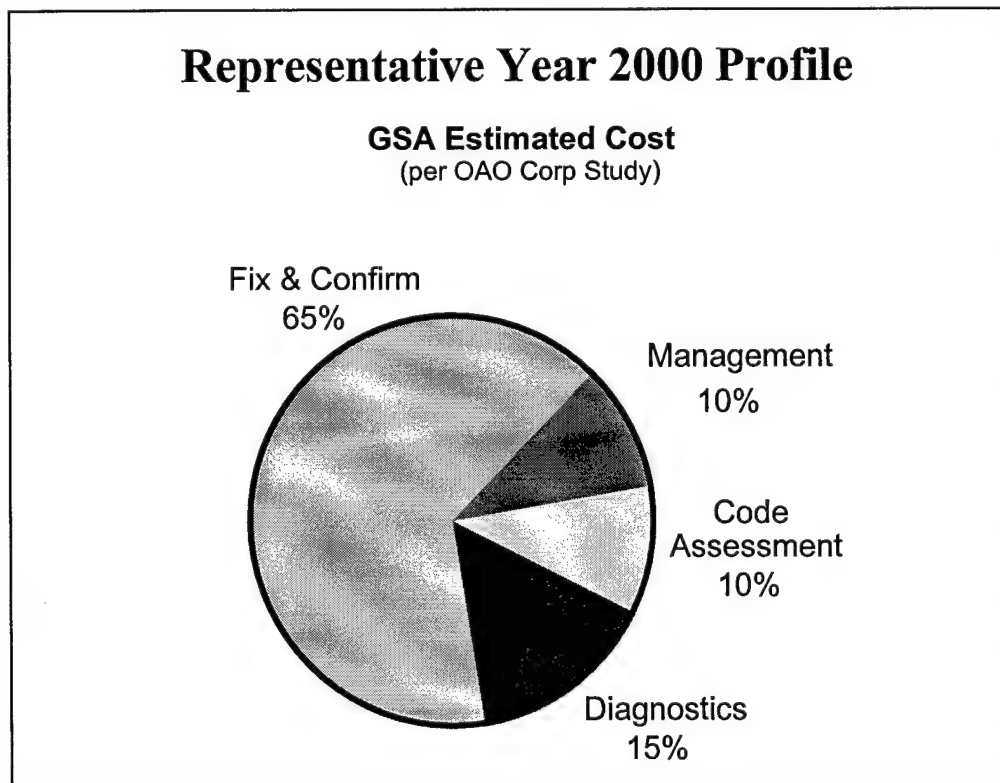


FIGURE 2

T&E Year 2000 Cost Profile

Figures calculated in accordance with model developed under GSA contract with OAO
All percentages are based on the total implementation cost, which the T&E Year 2000 team estimated at \$150M.

10 %	\$15.0M	Detailed problem assessment / business case includes 2 % (\$3M) for problem ID & planning
10 %	\$15.0M	Assessment of existing code to locate suspects
15 %	\$22.5M	Tools, diagnostics, & compliance testing
65 %	\$97.5M	Fix and confirm *
<u>100 %</u>	<u>\$150M</u>	

* The "fix" figure assumes entire cost of fixing T&E problems will be borne by the T&E community.
This amount may be reduced by gaining commitment from services, agencies, etc. to assist with solutions involving systems they support.

FIGURE 3

While this is the most sensible methodology, other alternatives exist. These alternatives, ranked for practicality include: a most critical systems approach whereby crucial systems such as payroll are attacked in sequence, an enterprise approach involving a holistic top-down assessment of the entire enterprise, and a re-engineering approach. The critical systems approach has great merit so long as critical system interfaces as previously discussed are factored into the systems evaluation rules. The enterprise approach may have merit, but requires a massive management commitment over and above necessary working level effort. The re-engineering approach, while attractive in concept, cannot not practically come to fruition in time for the immutable Year 2000 deadline. It is important to note that despite the selected approach, any Year 2000 solution demands a high degree of direct user involvement in all phases of activity. There is general consensus among the vendors that any turn-key contractor based strategy is bankrupt.

3. The T&E Year-2000 Team evaluated one promising technology to help ease the Year 2000 code assessment burdens noted above. Rather than parse the actual code, one firm, named DBSTAR, suggested that the actual data produced from the code held significant insights. These data could be assessed for highly probable data patterns concerning the manipulation of year based data. The DBSTAR tool set was initially developed to provide a map of legacy systems for purposes of intelligent systems re-engineering. This established data mapping code works with singular data sources such as a column of like data, large data matrices and whole systems of

related applications based data. When set to filter for year related data, theoretically the results yield instances of date relevant manipulations and isolates real date activity from mere date stamps. The problem is that the extent of fidelity, as of July 1, 1996 remains untested and, therefore, unproved. While the concept is sound, it is, however, based on some degree of statistical accuracy yielding less than a 100% solution set. Nonetheless, when used in conjunction with code parsing where practical, the emerging DBSTAR approach makes sense.

D. RELATED DOD ACTIVITIES: As evidenced by the growth in DoD sponsored Year-2000 Home Pages on the World Wide Web since the T&E Year-2000 Team initiated its activities, all the services are now deeply engaged in Year 2000 activities. These pages are rich in service based findings and contain many vendor specific tools and solutions. This level of service activity is further confirmed by direct liaisons established between the T&E Year-2000 Team and the Army, Navy and Air Force headquarters level teams. To date, most of these teams have produced nothing beyond the scope of what is reported herein. The Air Force headquarters C4 team, however, has devised a detailed service wide action plan that is gaining wide recognition in the Federal Government. This approach follows the sequential steps of awareness, assessment, renovation, validation and implementation. Under this tightly scheduled plan, 1999 becomes the year of testing. The salient fact, however, is that, as expected, the services are taking this matter very seriously. Another important contribution came via the well received Year 2000 study performed for DoD by the Mitre Corporation. It is also significant to note that certain Federal Acquisition Regulations have already been modified and will continue to be changed to rectify Year 2000 matters in Federal procurements.

Finally, a May 1996 publication, the Naval Information Systems Management Center (NISMC) Information Update, provided the following ASD(C3I) Year 2000 guidance:

- (1) Ensure vital systems do not fail from date change;
For Existing Systems, both:
 - Take corrective action during normal systems maintenance or upgrades, and
 - Embedded systems may need 'out of cycle' maintenance.*For New Systems:*
 - Ensure vendors will warrant fault free performance in processing data and date dependent data (including, but not limited to calculating, comparing and sequencing) from contract date, not the year 2000.
- (2) Report defects in key systems projected to extend into or beyond year 2000 through service or agency chain of command.

E. FINDINGS SUMMARY: The Year 2000 problem came seemingly out of nowhere and slapped a huge prospective bill on the DoD doorstep. As noted above, just how large this bill will be for the T&E community is difficult to ascertain. Unlike most business computing at corporate levels, T&E computer assets differ greatly and are widely dispersed within range sites making the matter of approximating costs to find and eliminate the problem circumstantial and exceedingly difficult to substantiate without significant investment in impact analysis. According to the testimony of managers and engineers interviewed for this task and the results of the tests, the Year 2000 flaw is present in at least some scientific and support computing at the ranges, but

its true dimensions are unknown. Even though the Year 2000 conversion's impact on range systems does appear on the surface to be minor, a lack of complete inventories of T&E system computer resources at the three sites studied limited identifying the true extent of what might be at risk. Further, without more extensive testing, the team can not say with certainty whether the perception of the Year 2000 problem is really relatively minor or whether more serious problems, undetectable by casual inspection, are lurking beneath the surface. Significant Year 2000 compliance problems seem to be found in older mainframe or stand-alone systems and their operating system software. Problems are almost universal in PCs, but the turnover rate of these computers minimizes the Year 2000 threat since replacements are known to be compliant. Finally, heightened awareness of the potential problem has been a major benefit of this quick look exercise. It is through such heightened awareness that progress shall be made across the board.

SECTION 3: RECOMMENDATIONS: Based on the statements of interviewees and the evidence from its cursory research and analysis, the T&E Year-2000 Team does not see a compelling reason to immediately launch localized teams of experts at the engineering applications or supporting hardware/firmware to ferret out all offending date instances in T&E. This is not to imply that the Team is satisfied that Year 2000 impacts are not hiding in scientific and engineering systems in the T&E community. The fact is that they are and will undoubtedly remain hidden in some applications and in some embedded code until they are discovered, either by intent or by accident! They do not appear, however, to be as mission threatening as is the case with business applications. The Team feels that as awareness grows scientists, engineers, and technicians will be alert to Year 2000 instances and more and more problem situations will be resolved. The Team also feels that there is sufficient time available to convert systems to Year 2000 compliance if awareness campaigns are sufficiently promoted and timely actions effected. Awareness was a chief concern at the outset, but the Team has seen the rise of several new efforts in DoD in response to this problem with a concern for both business and weapons systems.

A. RECOMMENDATION 1: There is the need to establish a centralized facility equipped with selected Year 2000 tools, an established Year 2000 methodology, established access to proven Year 2000 vendors such as are available through GSA, and a small cadre of experts trained in the methodology, the tools, and in assisting requesting commands to identify and resolve Year 2000 problems throughout the T&E community, and coordinate and track the effort DoD-wide. Therefore, the Team recommends the establishment of a "T&E Year-2000 Clearing House" to assist DoD components resolve their Year 2000 transition problems. As noted in Section 1., Year 2000 conversion in DoD is a major management issue. Technical considerations, as pervasive and challenging as they may be, are, nevertheless, secondary when compared to managing the effort. That is why the Team considers that a focused approach to the Year 2000 conversion effort is required. Otherwise each command must pursue the turn-of-the-century transition independently with attendant loss of uniformity and economics. Operating independently, commands may or may not acquire a Year 2000 tool set, hire contractors, assign staff and develop expertise in solving Year 2000 problems they consider unique to their individual environments. Moreover, once the crisis has passed, such investments will no longer be of use and would be considered lost as sunk costs. These costs could be significant if repeated at every range and will only increase as the elapse of time makes repairs more paramount. Thus, the "Clearing House" approach provides top T&E management a cost effective vehicle to ensure that attention is focused on discovering Year 2000 problems everywhere, uniformly resolving them, and reporting results.

An immediate task of this team would be to develop certification criteria for T&E System Year 2000 compliance. The team should be required to integrate its efforts with established Year 2000 Offices at the DoD and Service levels. Given the economy of scale through this clearing house approach, 2% of its estimated investment for immediate centralized problem identification and planning per the OAO model seems prudent. Thus, the team recommends an immediate "start-up" investment of \$3M for establishment and operations of the "T&E Year-2000 Clearing House" in FY97 with future funding based on measured "Clearing House" contributions. The

ultimate objective would be to make the "Clearing House" operation self sufficient by 1999 through its positive contributions to the T&E community and beyond.

B. RECOMMENDATION 2. Through the "Clearing House", aggressively promote awareness campaigns throughout the T&E community. Utilize the Tri-Service Range Commanders Council (RCC) Working Groups (data reduction and computers, electronic trajectory measurement, signals measurement, meteorology, telecommunications and timing, range safety, optical systems) to promulgate Year 2000 issues and investigate and report on areas of vulnerability or compliance. Likewise, energize management support throughout the Executive Agent to focus awareness and necessary compliance activities throughout the T&E community. Emphasis should also be given via electronic means such as the World Wide Web using as many sites as possible to popularize Year 2000 success stories, techniques and winning strategies. A good start may be to promulgate the contents of this report throughout the T&E community for critical review and comment. Such activity tends to heighten Year 2000 awareness and spirit the dialog necessary to engage a timely, proactive Year 2000 stance throughout the entire T&E community.

APPENDIX A:

MAR 19 1996

MEMORANDUM FOR CNO (N91)

FROM: Chairman, T&E Board of Operating Directors
4225 Logistics Ave, Suite 2
Wright-Patterson AFB OH 45433-5714

SUBJECT: Test and Evaluation Software Conversion for the Year 2000 Changeover
(DTSE&E Memo, Not Dated)

1. Per the subject memorandum, the Board of Operating Directors (BoOD) was tasked to establish a program to ensure that all systems expected to migrate through the Year 2000 are compliant with SECDEF Memorandum, dated 27 November 1995. Specifically, a plan of action and milestones (POA&M) was developed to assess T&E vulnerability to the Year 2000 problem, define the related business and technical impacts, review other organization's Year 2000 efforts, and identify a range of options for the T&E community to address this issue. This POA&M for the Year 2000 Software Issue is attached. Recommended funding source for execution of the POA&M are T&E Corporate Information Management (CIM) Central Funds. The estimated funding required was \$60K.
2. The subject tasker also requested a briefing on the plan of action to provide a plan to the Defense Test and Training Steering Group or the T&E CIM/EI Steering Council, as appropriate, in March 1996. The T&E CIM Director, Col Spencer, is prepared to present this briefing when directed.
3. The BoOD POC for this action is Col Spencer, T&E Joint Program Office (JPO), Director, DSN 858-4755.

\signed\
FRANCIS C. GIDEON, JR
Major General, USAF
Chairman

Attachment:
POA&M
cc: (listed on next page)

cc:

HQ USAF/TE

SAUS-OR

AMSTE-CG

Commander NAWCWD

AMSTE-TA

NAWCAD (5.1)

AFDTC/CD

HQ USAF/TER

DACS-TE

CNO (N913)

JPO(T&E)

NAWDWD/52D000D

Year-2000 Problem

Near Term Plan of Action and Milestones for T&E

OBJECTIVE: The objective of this POA&M is to develop a workable plan for the T&E community to deal with a "Year-2000 Problem" that involves year representation in automated systems and software. This POA&M is in response to an OSD/DTSE&E Memorandum date January 1996.

SCOPE: Assess T&E vulnerability to the Year-2000 problem, define the related business and technical impacts, review other organization's Year-2000 efforts and identify a range of options for the T&E community to address this issue.

BACKGROUND: There is a real risk that automated systems, including software applications, will yield inaccurate results at or near the century change if the year is represented using only two digits. This problem manifests itself when the year becomes "00". As the century cannot be determined, the computation on the "00" year can lead to totally inappropriate answers. Often a "00" or "99" in the automated year representation indicates an accepted "default" condition. In such cases, the year problem can manifest itself as early as the year 1999. This problem also immediately affects any forecasting system that expresses the year in two digits and projects into the next century. Even if a system is updated to account for four digit year representation, it is still vulnerable to other systems that feed it two digit year information. Such information is frequently embedded in "intelligent numbers", such as Job Order Numbers. Even many personal computers have design susceptibility to this fault.

ASD (C3I) has notified all DoD of the impending risk. The T&E community is vulnerable in real-time operations such as weapon system testing, range and flight safety systems, and time critical data processing where two digit year representation may be involved. The full range of business systems that support T&E are also in jeopardy of failure at or before the Year 2000. The recent "Year 2000 Blueprint for Success" conference, heavily attended by DoD, revealed that as many as 50% of all systems expected to still exist by 2000 may not be Year-2000 compliant. Conference speakers noted that a top down approach is required to achieve success. A SECDEF Memorandum of 27 November 1995 establishes Year-2000 guidelines for new start acquisition programs. Other DoD initiatives are taking shape.

APPROACH: Given the pervasive nature of the Year-2000 problem and the ongoing initiatives to address it, the T&E approach should be proactive but not duplicative. To formulate such an approach, we propose forming a small group of T&E experts to answer a number of key questions: determine the evolving guidance and other initiatives at service and related functional areas; assess the extent of T&E specific vulnerabilities and how to pinpoint them; and heighten universal T&E awareness of the Year-2000 problem and the range of potential methods and solutions that can be brought to bear. An assessment criteria may be developed by which high leverage T&E systems are identified early and targeted for Year-2000 upgrades. Issues dealing

with the timing of cross-functional changes must also be understood. These factors, and other pertinent Year-2000 information must then be folded into a comprehensive Year-2000 plan for the T&E community. The team will examine the Year-2000 issue, including: the extent of the problem in the T&E community, best practices for identifying vulnerable systems and applications, best practices for rectifying the Year-2000 problem when identified, means of identifying and addressing necessary interfaces with systems from other functional areas, methods for dealing with vendor supplied software, methods for documentation and other best practices from Government and industry.

PROPOSED STUDY TEAM: The approach to developing such a plan involves establishment of a short term team focused on the Year-2000 problem. This team, chaired by Mr. Jerry Brown of the Naval Air Warfare Center - Aircraft Division, Patuxent River, Maryland, will be composed of six BoOD/RCC selected members. Three will represent the services from the T&E business community and three will represent the services from the T&E engineering community.

SCHEDULE: The team will be stand-up in late March 1996. It will have 90 days to conduct research and prepare a comprehensive plan. It will report this plan to the BoOD.

RESOURCES: The support of this team will require \$30K for required travel and attendance at scheduled meetings. Another \$30K is required for contractor administrative support. Funding source is either T&E CIM funds or BoOD requested OSD funding to respond to this OSD task. Team salary shall be borne by the providing organizations.

LOGISTICS: The team is at liberty to identify its own logistics needs within the constraints of available resources. The T&E CIM office will assist in making necessary arrangements.

MEMORANDUM FOR BOARD OF OPERATING DIRECTORS

ATTN: MAJ GEN F. C. GIDEON, JR , CHAIRMAN
HQ AFMC/DO, 4225 LOGISTICS AVENUE, SUITE 2,
WRIGHT-PATTERSON AFB, OH 45433-5714

SUBJECT: Year 2000 Software Issues Funding -- INFORMATION MEMORANDUM

1. The Board of Operating Directors approved the Year 2000 Software Issues POA&M and recommended funding it from T&E CIM. During the T&E CIM Steering Council prebriefing, Mr. Burt observed that the Year 2000 Software Issue effort did not involve business process reengineering and therefore is not suitable for T&E CIM funding.
2. After reviewing all potential funding alternatives and the POA&M tasks, the JPO(T&E) has rescoped the tasks and reduced the cost for the quick action team (see attachment). We will implement the following actions and modifications to the POA&M:
 - a. The JPO(T&E) will provide TDY funding (less than \$10K) for the study team (funds for study team activity was included in the approved JPO administrative plan), and
 - b. The study team will request a limited amount of clerical support (about 5 days) from Patuxent River NAS -- the organization supporting the team leader, Jerry Brown.
 - C. The JPO(T&E) will sent the attached letter to the survey sites.
3. The JPO(T&E) point of contact for this effort is Colonel Ken Spencer, DSN 858-4755.

TODD STEVENSON, GS-15
Acting Director

1 Attachment
Action Plan for T&E Survey Team with cover letter

cc:
Commander, U.S. Army Test and Evaluation Command (MG Richard W. Tragemann), Aberdeen Proving Ground, MD 21005-5055

RADM Dana B. McKinney, Commander, Naval Air Warfare Center Weapons Division, Code 000000D, 1 Administrative Circle, China Lake, CA 93555-6001

MEMORANDUM FOR COMMANDER, ABERDEEN TEST CENTER
COMMANDER, AF FLIGHT TEST CENTER
COMMANDER, NAWC AIRCRAFT DIVISION

SUBJECT: Year 2000 Software Issues Survey Team

Senior government and industry officials have identified a potential serious problem associated with the date coding that will impact most computers and software in the Year 2000 (see attachment). The Test and Evaluation Board of Operating Directors (BoOD) has established a quick action team to survey the selected Service ranges and identify the risks of this serious problem to the T&E community. In the June, the BoOD will distribute a report of this team's findings to every T&E organization to help mitigate the impacts of this potential problem. Respectfully request your facility cooperate with this study team on a minimum interference basis and help to provide the T&E community an assessment of the severity of this problem.

TODD STEVENSON, GS-15
Acting Director

1 Attachment
Action Plan for T&E Survey Team

MILLENNIUM DATE CHANGE SURVEY

ACTION PLAN FOR T&E SURVEY TEAM

1. The dimensions of the millennium date change , commonly called the Year 2000 problem, are enormous. Given our reliance on computers , the failure of systems to operate properly can mean anything from minor inconvenience to major catastrophe: Licenses and permits not issued. Payroll checks not cut. Personnel, medical and academic records malfunctioning. Errors in banking and finance. Accounts not paid or received. Inventory not maintained. Vital supplies not ordered or received. Security locks not functioning. WEAPONS SYSTEMS NOT FUNCTIONING PROPERLY. Clearly, the Year 2000 conversion should be of substantial concern to DoD executives in both business and technical functions.

2. For the last 30 or 40 years, programmers have stored date information in "mm/dd/yy" format versus "mm/dd/yyyy" format to conserve space in disk storage and computer memory. They adjusted computations to take the two-digit year into consideration when computing time periods, ending dates, and the like. And they used the two-digit date to control certain program operations or for special purposes. At that time, most programmers and project managers figured that their programs would not last into the twenty-first century. They were trying to perform a service to their management by conserving expensive and limited disk space and computer memory. Adding two century digits to a date field could add several megabytes of storage requiring procurement of a disk that then cost upwards of \$20,000. It made economic sense to lop off the two century digits. This practice applied to some scientific as well as business programming and continues today where traditional methods are still practiced, although popular modern software languages now require the four-digit date field to be used.

3. Foremost in deciding what to do is estimating the extent of the problem. As a first step in arriving at this estimate for solving Year 2000 problems at T&E Ranges, the T&E Board of Operating Directors (BoOD) has established a quick action (90 day) team to focus on the problem. This Year 2000 team is comprised of representatives from each service. The team will use the case study approach concentrating on one range-site per service. It will attempt to assess the vulnerability, impact, range of options, and cost of fixes at each of the three sites. Generalizing from this information, the resulting findings and analysis will form the basis for scoping and recommendations for resolution of the problem across all Ranges. This alternative is within the team's practical means, involves all services using limited team resources, is scaleable and can yield a methodologically sound approach for others to follow. Data gathering will be by means of the interview method. Review and analysis of a variety of computer-related resource reports provided by the Range sites will augment the interviews.

4. The Range sites selected are TECOM, Aberdeen, MD; AFFTC, Edwards AFB, CA; and NAWCAD, Patuxent River, MD. The Year 2000 team initiated interviews at some sites the week of 15 April and expects to complete this phase of its plan before the end of May. I encourage your support of this effort at these places. The BoOD POC for this action is Col Ken Spencer, T&E Joint Program Office (JPO), Director, DSN, 858-4755. The Year 2000 team lead is Jerry Brown, Naval Air Warfare Center Aircraft Division, Patuxent River, MD, DSN 342-3335.

APPENDIX B:

STUDY METHODOLOGY OF THE T&E YEAR-2000 ASSESSMENT TEAM

The T&E Corporate Information Management (CIM) office in the Joint Program Office for T&E (JPO(T&E)) proposed formation of a T&E Year-2000 Assessment Team to the Board of Operating Directors (BoOD) for T&E. The proposal was approved by the BoOD on March 5, 1996. The team was assembled under the leadership of Mr. Lloyd (Jerry) Brown of the Naval Air Warfare Center Aircraft Division, Patuxent River, Maryland in late March. The tri-service team began meeting on April 3, 1996. The final report was due to the JPO(T&E) by early July 1996.

A. SPECIFIC TASKING: The T&E Year-2000 Team was tasked to develop a workable plan for the T&E community to deal with the "Year-2000 Problem". This plan is to assess T&E vulnerability to this problem, define the related business and technical impacts, review other organization's Year 2000 efforts and identify a range of options for the T&E community to address this issue.

B. ALTERNATIVES CONSIDERED: The T&E Year-2000 Team considered three leading alternatives to achieve its tasking within the assigned schedule:

1. TOP-DOWN WALL-TO-WALL SURVEY: The team seriously considered conducting a wall-to-wall survey of all software running within the T&E community as a first step to assess the impact of the Year 2000 problem. Some existing resources, such as the T&E CIM Automated Information System (AIS) study and the Joint Test Assets Database (JTAD) were evaluated as starting points. Upon further examination, however, neither of these resources were sufficiently detailed in terms of Year 2000 related information to yield meaningful results. Moreover, these resources, each resulting from top-down surveys of their own, took far longer than 90 days to compile. Thus, such an approach was deemed impractical for the near term. The team also felt that the services would eventually call for such extensive surveys, making the T&E effort in this area duplicative at best.

2 BENCHMARKING: The team also considered conducting a formal benchmark study on an organization similar in nature to the DoD T&E infrastructure. This idea was abandoned when the question of a suitable study partner with close parallels to the overall DoD T&E community in diversity and complexity became too difficult to answer. The team felt the extent of general acceptance of the Year 2000 transition problem in April 1996 was still too tenuous, even if a suitable benchmark study partner were to be identified.

3. CASE STUDY APPROACH: The team also considered focused case studies within identified portions of the T&E Major Range and Test Facilities Base (MRTFB). This approach used existing team resources to the fullest possible extent. The team felt that the findings from this

approach could be scaled for rough order of magnitude cost estimates and methodological approaches. This alternative was selected.

C. METHODOLOGY ADOPTED: The T&E Year-2000 Team adopted a case study approach combined with a complete survey of existing commercial trends toward resolving Year 2000 issues. The case studies applied to the three MRTFB facilities represented on the T&E Year-2000 Team. These facilities included: the Naval Air Warfare Center Aircraft Division, Patuxent River Maryland; The Air Force Flight Test Center, Edwards Air Force Base, California; and the Aberdeen Test Center, Aberdeen, Maryland. The Army's Test and Evaluation Command, which has oversight for all Army Development T&E activities, also participated as a contributor. The team was also augmented by direct consultation with Army, Navy and Air Force T&E participants serving on service based Command-wide Year-2000 teams. The T&E Year-2000 Team choose to use an interview method to collect relevant Year 2000 information from selected T&E Field Activity leaders. A copy of the agreed upon interview questionnaire is attached. The team focused primarily on T&E scientific processing systems operating within the MRTFB. It also examined T&E support tools often maintained within the base infrastructure level as a secondary priority. Finally, the team considered the large scale business systems affecting T&E which are frequently dependent upon CDA organizations or other non-T&E entities. Early in its existence, the team also agreed upon a format for this final report and a schedule of necessary events.

Questionnaire - Year 2000 Survey Team

1. To what extent does your organization directly support T&E?
2. What is your core T&E function?
3. Are you aware of the Year-2000 issue?
 - a) If aware - How are you affected (mission critical (e.g. safety system), minor impact (date on Xerox machine, phone LCD), etc)?
 - b) If unaware, do you have resources to assign to assess the impact?
4. What is being done?
 - a) External direction?
 - b) Local plans/action?
5. Do you have a complete inventory of all computer resources (hardware, software, firmware and archival systems).
6. Do you know which of your systems/platforms/computers are affected?
7. To what extent do external interfaces affect your internal operations (e.g. Flight Scheduling, supply, finance)
8. What are your estimated costs to become year-2000 ready
9. Are there other organizations you support or are supporting you that we should talk to?

APPENDIX C:

T&E YEAR-2000 TEAM INTERVIEW RESULTS

NAVAL AIR WARFARE CENTER - PATUXENT RIVER, MARYLAND

Mr. George Ryan (4/15/96).

Mr. Ryan serves as the director of the Atlantic Range and Facilities at NAWCAD. He was generally aware of the Year 2000 issue. He expressed a willingness to spread the word among his Department heads. He did not have a personal assessment of the scope of the problem or the cost to repair it, but felt it did have relevance to his organization. He was most supportive of further investigation of the problem.

Mr. Ron Runyon (4/17/96).

Mr. Runyon serves as the Deputy Comptroller at NAWCAD. He was generally aware of the Year 2000 issue. He was most concerned with the ability of Central Design Agents (CDAs) who support feeder systems such as NIFFMS, NALCOMIS, DCPDS to resolve their Year 2000 problems in an effective way before they affect NAWCAD corporate systems. He felt he was largely dependent on the Information Management Department (IMD) to resolve any lingering Year 2000 issues within local business systems upon which he must rely. He was fully aware of the ORACLE four digit date field convention. He felt archival data, which is used frequently, was particularly vulnerable. He cited RAPS, Travel On-Line, NIFMAS, PAXIS and the Command Workload Data Base as the key systems upon which he relies. He expressed a willingness to be part of the solution. He will assign a Comptroller lead to inventory all systems and assess priorities ,e.g., the current payroll system has two digit date fields. He felt every system that produced output through precalculation required scrutiny (e.g. all invoices). He expressed a strong need for IMD support. He felt this work, particularly on current systems, would have to be accomplished at night or over weekends on overtime. The workload with the increased Patuxent River population will be huge on its own right.

Production systems involve current transactions and, as such, are dynamic systems. He also felt much could be found and corrected through periodic data maintenance activities in so far as archived data were concerned as no transactions are typically run against such data. He expressed a need to reach out to CDA POCs and PMs to express our concern for their proactive response.

Mr. Chuck Lancaster (4/17/96).

Mr. Lancaster heads the Scientific and Engineering programming effort for NAWCAD, Patuxent River. His focus is on Computer Aided Software Engineering (CASE) tools, Training Ranges,

and the reduction of Telemetry and TSPI data. Computational Fluid Dynamics (CFD) and Structures are now largely done by the engineering competencies, 4.2 and 4.3. He was generally aware of the Year 2000 issue. He maintains some 300 programs. These programs are generally 20 years old. They are largely written in FORTRAN with more recent ones in C++. Photogramteric data reduction programs use Julian code for dates. Telemetry input comes in IRIG Julian date format. He possesses an 87 page abstract book listing these programs and their nature:

- Description of the Application/Program
- Capability/Utilization
- Name
- Program or Sub-program
- Aircraft or projects supported
- In-house or commercial
- Date of last update or review
- T&E areas supported
- Hardware required
 - Host
 - Operating system
 - Threading (multiple or single)
 - Network association(s)
- Unique features
- Limitations

He feels a test plan is required to seek and isolate Year 2000 instances, examine the potentially susceptible code, do the trade-offs, and make the fix. He will assign a Year 2000 lead to examine his computer systems for Year 2000 impact and provide the findings to this team. He suggested further investigation be conducted in:

- Metrology - Mr. Jimmy Fairfax
- Avionics and Mission Technology - Mr. Dan Dickey

Mr. Terry Collom (4/17/96).

Mr. Collom is responsible for instrumentation and its fabrication at NAWCAD, Patuxent River. He was made aware of the Year 2000 issue through a television spot he saw the preceding night. He sincerely felt the Year 2000 issue had minimal impact at first blush. He agreed with Mr. Rymer (see below) who laid the problem in the hands of the suppliers, be they maintenance contractors or Original Equipment Manufacturers (OEM). He was concerned about support systems such as Supply, which could affect his logistics flow. He agreed to have the problem examined more closely in his department.

The departmental report indicated, as expected, that the effect of business systems and Commercial Off The Shelf (COTS) products were the primary concern. Four internal inventory programs were cited as needing repair. They are:

- Ready Issue,

Tool Control,
AIC Lab Worklog, and
Requisition Tracking.

They were locally developed and can be corrected within a month. Further investigation is ongoing.

Mr. John Dawson (5/14/96).

Mr. Dawson is responsible for all electromagnetic effects laboratories at NAWCAD, Patuxent River. He was generally aware of the Year 2000 problem. He felt there was no perceived effect on his operation. He did survey his people. The largest threat is from desktop computers and they will all be replaced by 2000. His systems deal heavily in time, but do not involve date calculations. He acknowledged that Operating Systems should be examined in his older data systems. He felt his Halon removal program was a greater Year 2000 issue. It must be replaced by then by regulation and there are no funds allocated for its removal and replacement.

Mr. Ray Nowak (5/19/96).

Mr. Nowak is responsible for large scale Models and Simulations (M&S) and their design and conduct at NAWCAD, Patuxent River. These systems range from Force-on-Force combat engagements to single system performance. He is deeply involved in state-of-the-art growth via High Performance Computing. Growth has been astronomical since the advent of the Competency Aligned Organization (CAO) realignment. He was generally aware of the Year 2000 problem. In the main, he felt he had little problem. He uses state-of-the-art SGI equipment which, if not already Year 2000 compliant, will be made so by the OEM who is prompt about maintaining state-of-the-art integrity in this facility. M&S is time, but not date dependent. He did identify some areas worthy of further investigation. He had one older lab that used Encore gear (formerly Gould) that may be susceptible. He was involved in some C4I systems and associated data links that he felt required further scrutiny for date sensitivity. He was unsure of GPS and IRIG time based inputs and their effect, but suspected they would be minimal. He volunteered a report back in a week.

Mr. Bill Rymer (Email exchanges in early April)

Mr. Rymer heads the Telemetry operation at NAWCAD, Patuxent River, including the Real Time Telemetry Processing System (RTPS). He was initially unaware of the Year 2000 issue. He had a survey conducted of his operations for Year 2000 susceptibility. No significant threats were uncovered. Some minor operating system irregularities were reported. He felt the remedy responsibilities largely fell upon his vendors.

Mr. Steve Whetstone (5/15/96).

Mr. Whetstone was referred to the team by Mr. Jimmy Fairfax of Metrology. Mr. Whetstone heads the Laboratory Instruments and Standards Branch for Airborne Aircraft Instrumentation. This laboratory is responsible for calibrating test equipment used aboard aircraft, ships and in

other laboratories in the fleet, at ranges and other DoD activities. He was generally aware of the Year 2000 problem but did not foresee an impact on the work done in his lab. He stated that although no dates are used in doing the actual calibration work he would examine the computers for Year 2000 compliance and report the findings back to the team.

Subsequently, Mr. Whetstone reported that two types of laboratory computers are being used for calibrations of test equipment - - - Hewlett Packard (HP) and Fluke. The HPs support dates to the year 2080; however, the Flukes are not Year 2000 compliant at all and will only operate when dates before 2000 are entered. Mr. Whetstone stated that the Flukes are used in 10% - 15% of the work, the HPs in 50%. Computers are not used in the remaining 35% of the work. The Fluke OEM will not support upgrades to alleviate the operating system Year 2000 flaw; however, Mr. Whetstone states that both the HPs and the Flukes are being phased out well before 2000 and their replacement(s) will be Year 2000 compliant.

Mr. Dan Dickey (5/15/96).

Mr. Dickey is head of Strike Missions System Branch. He was generally aware of the Year 2000 problem but perceived no impact on his operation. His department uses Macintosh, personal computers (PC), and an HP UNIX for project work. He offered to have systems checked for Y2000 compliance and report the findings back to the Team.

Upon setting the computer systems' clocks to a Year 2000 date, tests were conducted on the Macintosh and PC types of computers. As expected, the Macintosh systems exhibited no Year 2000 anomalies as they are known to be Year 2000 compliant. The one PC checked, a COMPAC, appeared to accept the Year 2000 date when the MS DOS date parameter was set. It responded normally when project applications were run. However, when the application created a file, the computer's File Manager saved that file with an erroneous and unrecognizable date, i.e., 1/1/:0. This signifies that the computer software has Year 2000 problems.

Generally, Mr. Dickey's staff is of the opinion that the current software running on desktops - functional applications, COTS office applications, and operating systems - will not be running at the turn of the century. They felt that the hardware platforms won't be around either and that replacement systems will be Year 2000-ready. See Note.

Note: These test results are typical of most PCs tested at this site. It is pointed out, however, that the problem isn't completely pervasive or all-inclusive. Late model PCs do not exhibit Year 2000 problems. Their Basic Input Output System (BIOS) chip has been upgraded for Year 2000.

Mr. Mike Hardman (4/10/96)

Mr. Hardman is the senior electronics technician responsible for development and maintenance of the Multiple Target Instrumentation Radar (MIR) at Chesapeake Test Range. He was aware of the Year 2000 problem and his first impression was that this would not affect the MIR's operation. A complete inventory of computer hardware/software for the radar was not available.

He agreed to run Year 2000 date tests on the radar's computer (a Harris Corp. H1000-2C super mini) and software applications.

Preliminary tests revealed that the radar computer operating system (HVOS) would not accept Year 2000 dates, refusing to boot up. Inquiries to the manufacturer (Harris Corp.) revealed that they were not aware of this problem. Harris is investigating whether newer versions of the operating system (current version is 8 years old) are compliant. The radar's application programs do not use any date information so are unaffected. The impact is considered minor since the problem will not down the radar system or cause any operational problems.

Mr. Henry Shupe (5/15/96)

Mr. Shupe is a computer scientist responsible for development and maintenance of three Vitro RIR-778 radar systems at Chesapeake Test Range. He was not aware of the Year 2000 problem. A complete inventory of computer hardware/software for the radar was not available. He did not know if his systems would be impacted but agreed to run simple Year 2000 date tests.

Preliminary test results revealed that the radar software/hardware are Year 2000 compliant. New radar computers are expected to be installed prior to the Year 2000 and they will be specified to be Year 2000 compliant.

Mr. Bruce Burnsed (5/30/96)

Mr. Burnsed is a senior computer scientist for Vitro Corp. and is responsible for development and maintenance of range radar systems through the Instrumentation Radar Support Program (IRSP). The IRSP supports the Navy, Army, Air Force, NASA, DOE, and U.K. test and evaluation ranges. He was aware of the Year 2000 problem but had not taken any action to respond to the problem. His first impression was that this was not a problem which would impact range radar systems. He said he needs to conduct tests and investigations to determine any impact. No results have been reported to the team to date.

Mr. Sam Schrader (5/16/96)

Mr. Schrader is responsible for the Passcard security systems at Chesapeake Test Range. The Passcard security systems control access to the facility. He was not aware to the Year 2000 problem. A complete inventory of computer hardware/software for the Passcard security systems was not available. He did not see any impact that Year 2000 would have on the Passcard security system but could not say for certain.

Mr. Dick Stepanian (4/30/96)

Mr. Stepanian is responsible for computer/software configuration management at the U.S.A.F.'s 30th Space Wing at Vandenberg AFB. He was aware of the Year 2000 problem. He stated that this was not an issue at their range because of a planned replacement of all range

systems/equipments under the RSA (Range Standard Architect) program. This program is scheduled to be completed prior to 2000.

Mr. Ken Clarke (5/29/96)

Mr. Clarke is Program Manager for the GPS office at Chesapeake Test Range. He was aware of the Year 2000 problem. A complete inventory of computer hardware/software for the GPS systems was not available. He stated that the only date information used in GPS systems was IRIG based and that this utilized the Julian date format. He felt that the Year 2000 problem would not have any impact. (However, see Joe Gwinn message below.)

Mr. Tony Winkleman (6/18/96)

Mr. Winkleman is Program Manager for the Real Time Dynamic Radar Cross Section (RCS) Test Facility at Chesapeake Test Range. Mr. Winkleman advised the team that Y2000 tests he performed on the radar controller computer (Motorola Unix Version 3.5.1) demonstrated that it will not except dates beyond 1999 on input. Attempts to enter any year in the two digit year field between 00 and 69 are reset to 70. However, the system appeared to successfully "rollover" to 2000 when the system date was advanced to 12/31/99. Subsequently, new files were apparently correctly dated with Year 2000 creation dates. Regardless, the inability to input correct dates would be detrimental to the operation of Mr. Winkleman's function. He anticipates this machine will be replaced before 2000.

Mr. Joe Gwinn (6/26/96)

Mr. Gwinn is an engineer at Raytheon. The information below was provided by him via email to interested parties and was not obtained by Year-2000 Team interviewers. His message is included here with his permission.

Subject: The Millennium comes early to GPS

I have good news and I have bad news.

The good news is that GPS will not have a "Year 2000" problem.

The bad news is that GPS System Time will roll over at midnight 21-22 August 1999, 132 days before the turn of the millennium. On 22 August 1999, unless repaired, many or all GPS receivers will claim that it is 6 January 1980, 23 August will become 7 January, and so on. I would expect that some manufacturers have already solved the problem, but many have not.

The details: Section 3.3.4(b) (page 33) of the ICD-GPS-200 rev B (30 November 1987 issue) states that the GPS Week count starts at midnight 5-6 January 1980 UTC, and that the GPS Week field is modulo 1024. This means that the week count will roll over $1024/52 = 19.69$ years from then, or in $1980 + 19.7 = 1999.7$ (August 1999), only a few years from now.

For the record, this is how the precise rollover date was computed: The origin (time zero) of GPS System Time, 00:00:00 UTC 6 January 1980, is Julian Day 2,444,244.500. A GPS Cycle is 1,024 weeks, or 7,168 days, so the first GPS rollover will occur at Julian Day $(2444244.5 + 7168) = 2,451,412.5$, which is 00:00:00 UTC 22 August 1999 AD, which is the midnight between Saturday night the 21st of August, and Sunday morning the 22nd of August, 1999.

I could find no mention of any field in any GPS message that would tell you which 1024-week cycle you were in. In the July 1993 update of ICD-GPS-200, a note has been added (also on page 33) saying that the week number **will** roll over, and that users must account for this, but no way to accomplish this is mentioned. I take this note as further evidence that there is no way to tell, given only the signal-in-space definition as of July 1993. (I have been unable to find ICD-GPS-200 on the web. I am told it may be obtained from the GPS Program Office, in the US Air Force.)

I now have found a more recent authority document to reference. The GPS SPS Signal Specification, 2nd Edition, issued on 2 June 1995, repeats the words and warnings of ICD-GPS-200. The GPS SPS Signal Spec does cover the bulk of what's in ICD-GPS-200, and covers the rollover problem exactly as well as does ICD-GPS-200. The GPS SPS Signal Specification may be obtained from the web as an Adobe Acrobat (.pdf) document, at "www.navcen.uscg.mil/gps/reports/sigspec/sigspec.htm".

I have posted notices to a number of relevant newsgroups (NTP, GPS, and Risks). So far, nobody has even claimed that rollover won't happen, let alone provided a convincing argument. I did get one now-explained then-inexplicable war story, and a number of questions, and a few thank-you notes. But, it's been a lot quieter than I would have thought. I think that many more people care about navigation accuracy (unaffected) than time accuracy (sometimes severely affected). And, not that many people read such arcane newsgroups.

A fellow at DEC, reacting to my postings, suggested that one can use the offset between UTC and GPS, currently eleven seconds and increasing more-or-less linearly, as a way to tell which 1024-week cycle you are in, at least for the next few cycles. I have looked into this, and it does appear to be workable, if rough. If one burns both the date of manufacture and the then-current value of the GPS-UTC offset into the firmware, it should allow the firmware to solve the rollover problem for at least three GPS cycles, almost 60 years, which should suffice. The leap-second story is at "<http://tycho.usno.navy.mil/leapsec.html>".

I have gotten some email traffic indicating that, just as I had suspected, some manufacturers did realize that GPS would soon roll over, and were keeping it to themselves in the hope that the others would fall upon their swords. I have subsequently found more indications that some manufacturers know, but are keeping it to themselves. One claims to have a solution, the details of which are proprietary. Not pretty.

Our supplier was dumbfounded when I raised the issue, couldn't stop thanking me for pointing it out years before rollover. They clearly feel that it could have been a life-threatening disaster for

them. Every GPS-related product they had ever made would have come back for repair, many under warantee, all at once. Too close for comfort. And, discovered by luck.

The firmware in all affected (older) units will have to be replaced. This will involve replacement of PROMs; some are socketed, some are soldered. New units presumably will know better than to claim dates from before they were manufactured, and/or will allow the user to directly or indirectly tell the firmware which 1024-week cycle to assume, without requiring replacement of that firmware at the second rollover, in $1980 + (2 \cdot 1024 / 52) = 2019$ AD. Some of this equipment will still be in use then, long after the manufacturer has forgotten the product, or has himself been forgotten. Nor is it guaranteed that the needed PROMs will still be available.

However, in spite of everything, not everybody will get the message, so system software will forever have to have an independent idea of what year it is, to know when to disbelieve a receiver or receivers (they could all be wrong), and to handle arguments between various GPS receivers (if only some are wrong).

Without a GPS Simulator, there is no way for users to test a GPS receiver for this problem. All most users can do is to ask their manufacturer for a solution, and also to imbue the system software with a suitable degree of skepticism about GPS receivers' sense of time.

My intent in posting this note is to alert the entire industry to the problem, allowing it to be solved with minimal disruption to all. As a technical matter, the solution is quite simple. It's the logistics that will take some years.

AIR FORCE FLIGHT TEST CENTER (AFFTC), EDWARDS AFB, CALIFORNIA

Interview Results

Informal interviews/discussions concerning the potential impact of the Year 2000 (Y2K) problem were held with key personnel located in the business, infrastructure, range and engineering areas at the AFFTC. In general, those interviewed were aware of the Y2K problem. In addition a total of 131 systems were reviewed and broken down into the following categories:

- Locally Developed Business Systems
- PC Systems/Applications
- Engineering/Range Systems
- Comm/Computer Infrastructure

A synopsis of the interviews by functional area follows:

Locally Developed Business Systems

Ms. Julie Karr
Capt. David Winters

Mr. Carl Pee

The major Center wide business systems that are expected to continue beyond 2000 are believed to be century aware and will not suffer significant failures. All of these systems have been developed within the last 10 years with significant hardware/software upgrades occurring within the last two years. The systems employ platforms (DEC Alpha), operating systems (UNIX) and software (Oracle, Sybase) that are reportedly Y2K compliant. Initial programmers and those doing follow-on maintenance/upgrades are generally Y2K aware. The overall feeling is that very minor problems, if any, will occur after the Y2K change.

PC Systems/Applications

Mr. Pete VonKlargaard
Mr. Don Knight
Mr. Bruce Berger

It was generally felt that the PCs currently being used across the Center would have a minor, if any impact at all. The majority of the systems being used are expected to be replaced prior to the Year 2000 and those that may remain in service are felt to be century aware. Some applications currently in use have been identified as having date problems (DB II, DB III, Access). However it is anticipated that these applications will be replaced or upgraded prior to the Year 2000.

Engineering/Range Systems

Dr. Henry Bunch
Mr. Mike Hughes

The primary engineering/range support systems have been replaced/upgraded over the last two years. It was felt that the hardware/software/operating systems currently being used are century aware and will not suffer significant problems. Other range instruments such as radar systems, cine-t's, etc., are also planned for upgrade, replacement or mothballed prior to the Year 2000. The overall feeling was that the Y2K will only bring a minor impact to the range/engineering systems.

Comm/Computer System Infrastructure

Mr. Pete VonKlargaard
Mr. Bruce Berger

Some concern about the impact of Y2K on the overall infrastructure was expressed, however, no specific problems were identified. A new telephone switch is currently being installed that the vendor claims is Y2K compliant. Studies, such as Mitre, have reported suspected problems with telephone switches but confirmation of such as not been shown. Further research is being done to determine if a problem exists. The impact on Y2K on the network infrastructure is also unknown. The network consists of numerous routers, gateways, etc., that all could be subject to

some level of failure. However, no vendors or studies have identified specific problems. Testing methodologies also seem to be non-existent for many of these components.

Other Concerns

Air Force Standard Systems - Numerous AFFTC functions are dependent upon Air Force Standard Systems. The impact of Y2K on these systems is unknown at the present and cannot be locally determined. These systems are developed and maintained by the Standard System Center (SSC) at Gunter AFS, AL. The SSC is evaluating these systems for Y2K impact.

Embedded Systems - The impact of the Y2K on systems embedded within aircraft could not generally be determined at the local level. Embedded systems will be evaluated by the specific Major Commands, Special Project Offices.

ABERDEEN TEST CENTER, ABERDEEN, MARYLAND , and

TEST AND EVALUATION COMMAND, ABERDEEN, MARYLAND

Ms. Eileen Viars (4/24)

Ms. Viars is the Senior Computer Specialist for the Computer Operations Division at Aberdeen Test Center (ATC). Her division is responsible for the collection, processing and reporting of test data for all test and evaluation decision makers. Her division is aware of the Y2K problem. She is responsible for running the HP 9000/3000 minicomputers and the local area network (LAN) . Her department is waiting Year 2000 software patches from Hewlett Packard. Other software developed in-house will be modified there. The greatest impact will be from systems external to ATC, i.e., Cost Accounting, Test Resource Management System (TRMS) and the Defense Finance & Accounting Service (DFAS). She estimates the cost to become Y2K ready will be \$3,000.

Mr. Steven Hawbecker (5/3)

Mr. Hawbecker is a Mechanical Engineer for the Physical Test Division at ATC. His division is responsible for conducting testing on toxic fumes data acquisition, alternative fire suppressants and refrigerants and chemical analysis. They are aware of the Y2K problem. They feel that there will be a minor impact, all test data does not have date/time fields in it. The only problem would be in the incorrect date on the hardcopy printouts. They are assessing off-the-shelf and locally written data reduction software for impact and realize that all PC's will need to upgrade the BIOS. His department is checking with the workstation manufacturers (SUN and Silicon Graphics) to determine if the problem exists and if these OEMs are preparing a solution. They estimate a cost of \$1,000 to become Y2K ready.

Mr. Dave Jennings (5/14)

Mr. Jennings is Chief, Optical Engineering Division for ATC. His division provides visual documentation of RDT&E testing to include ballistic, automotive and live fire testing of Army materiel. He is aware of the Y2K problem and a minor impact is anticipated. Date/time fields are not a critical element in operating camera systems. They have PC's and commercial software which will be updated by the manufacturer. They do not estimate any costs will be incurred for Year 2000 corrections.

Mr. John Gerdes (5/14)

Mr. Gerdes is an engineer in the Radiation & Simulation Directorate of ATC. This directorate is responsible for monitoring X-rays, health physics, customer data acquisition, and systems analysis. They are aware of the Year 2000 problem and have done their own analysis. All old PC controllers (BIOS) will be upgraded. Most computers will be replaced with new models before 2000. Software fixes will be prepared for laboratory programs. They have estimated a cost of \$200-\$300K and six man-months of effort.

Mr. Bill Burch (5/14)

Mr. Burch is an environmentalist in the Environmental Office of ATC. His department is aware of the Y2K problem. His office tracks hazardous waste materials and all such information is stored in a database of the Hazardous Waste Tracking System. This system resides on a minicomputer maintained by the Directorate of Information Management (DOIM). DOIM interfaces with the DoD Environmental Network Information Exchange (DENIX) in Washington DC. His opinion is that there will be little or no impact to his operation due to the Year 2000 transition.

Ms. Rebecca Joy (5/2)

Ms. Joy is an engineer in the Technology Directorate of ATC. Their main function is to track multi-spectral signature measurements of military targets. All data is housed in a Unix based minicomputer running Oracle. This office interfaces with the National Ground Intelligence Center (NGIC) which has developed a system that is linked over a network with twelve other sites. They are investigating the availability of Year 2000 training necessary for one of their employees to make modifications to their in-house programs. They estimate costs of \$5K.

Mr. Tom Lockard (16 May)

Mr. Lockard is the Chief, Computer Operations for the Directorate of Information Management (DOIM). The DOIM supports the T&E Command (TECOM) for ongoing system/program maintenance and production execution of the Test & Evaluation Analysis Management-Uniformity Plan (TEAM-UP). One of these systems is the Test Resource Management System (TRMS) which is the primary information management tool for TECOM's testing mission. They are aware of the Y2K problem. This office maintains and supports the IBM mainframe and

minicomputer systems for 57 tenants at APG and the TECOM Test Centers. The department uses COBOL on its mainframe, but runs Oracle and Informix on its minis. The DOIM is forming a team to assess the magnitude of the Year 2000 problem. They have already started talking to vendors. A cost analysis of \$6M was calculated based upon rough estimates of the number of lines of COBOL code and industry projections for cost per line.

APPENDIX D:

TESTING YOUR DESKTOP FOR YEAR 2000 COMPLIANCE

For MACs:

- A. From the Control Panel select "Setting Date And Time".
- B. Using the up/down arrows:
 - 1). Set the date to 12/31/99.
 - 2). Set the time to 11/59/01 (minutes and seconds are arbitrary).
- C. Select OK or CLOSE the dialog box.
- D. Select "Setting Date And Time" again.
- E. The date should be at 12/31/99 and the time should be advancing.
- F. Wait until the date changes (should roll over to 01/01/00).
- G. Time should be advancing.
- H. Close the dialog box.
- I. Create and save a file.
 - 1) Select the Apple icon from the menu bar.
 - 2) Select the file type (ex: Microsoft Word) from pull down menu.
 - 3) Select File from the menu bar.
 - 4) Select New from the pull down menu.
 - 5) Select the desired Template (ex: Normal).
 - 6) Enter anything into test file.
 - 7) Select File from menu bar.
 - 8) Select Save or Save As from pull down menu (save to your Desktop).
 - 9) Enter the document (file) name (ex: testy2k.doc).
 - 10) Select Save.
- J. Select File from the menu bar.
- K. Select Quit from the pull down menu.

- L. Highlight the file you created from the Desktop.**
- M. Select File from the menu bar.**
- N. Select Get Info from the pull down menu.**
- O. Verify that the file create date is Jan 1, 2000.**
- P. If the file create date is correct your MAC computer is Year 2000 compliant . If the create date is not correct your MAC is not compliant.**
- Q. Delete the test file (drag the file icon to Trash can).**
- R. Reset the date and time to today's date and the correct time.**

For PCs:

- A. From your Program Manager Desktop menu select Main.**
- B. From Main select Control Panel.**
- C. From the Control Panel select Date/Time.**
- D. Using the up/down arrows:**
 - 1) Set the date to 12/31/99.**
 - 2) Set the time to 11/59/01 (minutes and seconds are arbitrary)**
- E. Close the dialog box.**
- F. Select the Date/Time icon again.**
- G. The date should be 12/31/99 and the time should be advancing.**
- H. Wait until the date changes (should roll over to 1/1/00).**
- I. If the date doesn't change correctly your PC isn't year 2000 compliant. You can set the date to 1/1/00 and continue test at Step K if desired, but date will fail.**
- J. If the date is correct continue test.**
- K. Close Date/Time dialog box.**
- L. Close Control Panel and Main. You should be at Program Manager Desktop.**
- M. Create and save a file (select Microsoft Word, for example).**
 - 1) Enter anything into the test file.**
 - 2) Select File from the menu bar.**
 - 3) Select Save As from the pull down menu.**
 - 4) Enter the File Name in the highlighted blue box (ex: y2ktest.doc).**
 - 5) Select a Directory to store the file.**
 - 6) Select OK (double click on the OK).**
- N. Select File from the menu bar.**
- O. Select Close from the pull down menu.**
- P. Exit Microsoft Word (for example).**
- Q. Select File Manager from menu bar.**
- R. Select Directory where the file was stored.**

S. Select View from the menu bar.

T. Select All File Details from the pull down menu.

U. Highlight the file you created.

V. Verify the date the file was created is correct (0/1/00). If incorrect (1/1/:0 for example) your PC is not Year 2000 compliant.

W. Delete the test file (select File, select Delete from the pull down menu, select YES from the next three dialog boxes).

X. Exit File Manager.

Y. Reset date and time.

The Reason:

The standard PC computer system maintains two system dates; one is in the CMOS Real Time Clock chip - a hardware component that is normally on the machine's motherboard - and one is in the DOS (and Windows) operating system software. These two dates are represented differently. The CMOS RTC date is kept as century/two-digit-year/month/day and the DOS date is kept as days-since-1980/01/01 which is converted to four-digit-year/month/day when any program asks for it. When DOS boots, it normally initializes its current date by reading the date in the CMOS RTC and converting it to days-since-1980/01/01. DOS maintains its date as long as the system is running; the CMOS RTC hardware maintains its date whether the system is running or not, but it does not maintain the century. In the CMOS RTC, year 99 overflows to 00 and the century remains unchanged so the effective year becomes 1900; in DOS year 1999 overflows to 2000. So until the system is rebooted there will appear to be no problem with the transition from year 1999 to Year 2000; but trouble lurks in the CMOS RTC date, which has become year 1900. When DOS boots it reads 1900 as an out-of-range date from the CMOS RTC and the date conversion algorithm calculates an erroneous 1980-01-04. That's what the DOS date will become after rebooting the system after the Year 2000 transition if the CMOS RTC exhibits the standard flaw.

Another Test:

To determine if your system suffers the Year 2000 CMOS RTC flaw, from a DOS prompt set the date and time to:

Power off test:

C:>DATE 12-31-1999

C:>TIME 23:59

Power off the system, wait more than one minute,

Power on the system. Allow the system to boot.

Check the DOS date. It should read 01-01-2000. If its not (usually 01-04-1980) your machine has the flaw.

Power on test:

C:>DATE 12-31-1999

C:>TIME 23:59

Wait for more than one minute.

Check that the DOS year has changed to 2000.

Reboot. The DOS year should still be 2000. If it does not your machine has the flaw.

For a Year 2000 solution for your PC refer to the following WEB site:

<http://rampages.onramp.net/~gtbecker/>

APPENDIX E:

Matrix of Commercial Offerings to Resolve Year 2000 Questions

<u>VENDOR PRODUCTS & SERVICES</u>	<u>YEAR 2000 EXPERIENCE</u>	<u>YEARS IN BUSINESS</u>	<u>METHODOLOGY</u>	<u>AREAS OF EXPERTISE</u>	<u>PLATFORMS/LANGUAGE SUPPORTED</u>
Adpac Corp.		30	YES	Locates application data fields;	MVS Operating System, including
"SystemVision Year 2000"				prepares detailed cost estimate;	MVS/XA and MVS/ESA supporting
San Francisco, CA				allows "what if" modeling for	products that run in COBOL, PL/I,
415-777-5400, Fax 415-546-7130				assessment of different change	Assembler, JCL, SQL, DB2, IMS,
adpaccorp@aol.com				methods; supports automated code	IDMS, CICS, IDD
				changes; menu driven; repeatable,	
				verifiable; impact analysis.	
Alydaar S/W Corp		14		Uses artificial intelligence product	General
"SMART CODE"				to find and fix every Y2K problem	
705-544-0092				in software systems ---	
Fax 705-544-0260				synthetically. Core business goal	
				is reengineering solutions.	
AMAR Systems Inc./ TTSC			YES	Planning - assesses app portfolio	MVS
Date2000 Solutions				Exposure Id- detects date refs	
c/o Technology Transition Support				Exposure Solution - correct, migrate,	
9801 Broken Lane Pkwy, Suite 103				test a Year 2000-ready system.	
Columbia, MD 21046				Produces inventory of software,	
410-995-6060				checklist for Y2000, Imp plan. Toolkit	
Fax 410-995-6061				product allows conv & testing apps in	
"Date 2000"				piecemeal fashion. Conv data files	
Andersen Consulting			YES	Impact Analysis	General

				Conv Planning	
				Code Conv & Data Conv	
				Testing & Implementation	
				Expertise in change analysis,	
				config mgmt, and testing techniques	
CAPGEMINI AMERICA	9		YES	Uses artificial intelligence tool set.	
"Transmillennium Services"				Uses their Application Renovation	
Iselin, N.J.				Center (out source) to leave your	
908-906-0400, Fax 908-906-0969				ongoing operations undisturbed.	
New York, NY				"A factory: a highly disciplined,	
212-944-6464 ext 232				tool-supported outsourcing vendor	
Fax 212-944-8760				who can save money and provide high quality deliverables.	
Computer Associates			YES	Pre-packaged solutions and	Source code, JCL, PROCS
One Computer Associates Plaza				conv assist for Y2K efforts.	Database conv, documentation, MVS,VSE, PC Workstations
Islandia, NY 11788-7000				S/W driven impact assmnt on mainframes/PC workstations	
516-342-5224				Detail info on date fields	
				Inventory, LOC, number and % on date fields	
"CA Discovery 2000"				Y2K project plan, impact anal	
				imp, unit and system tests,	
				regression tests, deploy, LCM	
Computer Horizons Corp.	26		YES	Five phased approach from	A service for converting
"Signature 2000 Solution"				discovery (assessment) to	mainframe COBOL applications
Mountain Lakes, NJ				implementation. Creates application portfolio,	
800-321-2421, Fax 201-402-7988				then analysis,	
				construction, testing and	
				implementation.	
				A service for converting main-	
				frame COBOL applications	
				Impact Analysis	
				Conv Planning	
				Code Conv & Data Conv	

				Testing & Implementation	
				(Automated and Manual)	
Computer Reserves, Inc.			YES	Impact Analysis and Metrics	MVS/COBOL, BAL code, Assembler,
800-882-0988				Conv Planning	AS/400, Natural
				Project Ident	
				File Processor	A mainframe-based conversion
				Automatic Code Modification	product that reduces conv time by
					orders of mag compared to running
					on Pentium PCs
Compuware Corp.					Products run in standard operating
"Xpediter+, Pathvu, Xpediter/Xchange,					environments, including IBM MVS
File-Aid, DBA Expert to DB2, Retrofit,					and TSO/ISPF and support IBM
Playback"					COBOL, OS/VS COBOL, and COBOL II
Farmington Hills, Michigan					
800-521-9353					
http://www.compuware.com					
Coppers & Lybrand			YES	Impact Anal - source code scan and	Business Systems
1751 Pinnacle Drive				econometric modeling to create	
McLean, VA 22102-3811				conv/proj plan	
703-918-3716				Reqmnts Anal & Solution Def	
Fax 703-918-3764				Sys Delivery Spec	
"Diagnostic2000"				Test Plan	
				Tech/User Procs & Conv	
				Acceptance Testing	
				Transition	
Data Dimensions, Inc.	5	28	YES	Impact Analysis	COBOL
"Template 2000"				Conv Planning	
206-688-1000				Code Conv & Data Conv	
Fax 206-688-1099				Testing & Implementation	
				A full service millennium	
				consulting computer company that	
				provides conversion planning and	
				implementation support for Y2K	

				problems. Provides extensive	
				costing & resource requirements	
				analysis. Done on an application-	
				by-application basis which are	
				then rolled into a portfolio sizing	
				report. Pilot project focus. 800	
				million lines of code evaluated	
				since 1991, over 1 billion under	
				review.	
Decision Systems Technologies, Inc. 6301 Ivy Lane, Suite 600	Currently supporting IRS	Since 1986		A systems engineering and S/W engineering company.	Unisys 2200, Sun SPARC Workstations, 486/66 PCs, Unix Lan, COBOL, Windows for Workgroups,
Greenbelt, MD 20770				300 professionals. Focus is	MSO Open, Microfocus, ORACLE, SUN Solaris, more
				systems development, exec	
301-441-3377				info systems, reengineering,	
Fax 301-441-4571				network integration and mgmt,	Has several IDIQ task order contracts via Fed Agencies
				systems integration, info engineering. Y2k is primarily consulting, strategy, planning.	
DBStAR, Inc 185 Berry Street San Francisco, CA 94107-1729 415-512-0300 Brian Boyle				Tool examines actual data artifacts vice code parsing. Assesses for probable data patterns. Resulting annotated data maps can also serve as analytical tools for reengineering efforts..	Analytical tool for data artifact analysis
General Services Administration				Federal Information Systems Support	
Technical Services Div				Program (FISSP). Provides reqmnts	
7th & D Sts. SW, Rm 6109				contracts to meet IT needs of Fed	
Washington, DC 20407				agencies. Provides existing procrmnt	
202-708-7700				vehicles. Assists SOW, issues RFP,	
Fax 202-708-7714				evaluates proposal, negotiates task	
				order, administers task. Has	
(see OAO below)				precompeted contracts for Y2K.	
IBM				"The Year 2000 and 2-Digit Dates:	

"Year 2000 Customer Guidance Paper"				A Guide for Planning and	
http://www.S390.IBM.com/stories/pr2000.html				Implementation"	
IBS Conversions, Inc.		4		Impact Analysis	COBOL
"IBS/Solution 2000"				Conv Planning	
708-990-1999				Code Conv & Data Conv	
Fax 705-571-0723				Testing & Implementation	
Intersolv			YES	Provide service direct consulting:	COBOL, CICS.BMS, DB2, IMS
"Intersolv Maintenance Workbench"				assess, identify impact, plan,	
webmaster@intersolv.com				test, implement changes; stream-	
				line maintenance, synchronize	
				production environment versions	
ISOGON Corp 330 Seventh Ave New York, NY 10001 212-376-3200/800-568-8828 "TICTOC"		Since 1983	NO	S/W for testing MVS/ESA and MVS/XA using virtual dates. Tests for Year 2000 and beyond. Transparent to apps. No code/JCL changes. All data formats (dec, binary, microsecs, etc.) Softaudit Identifies load mods and source mods, tracks usage, counts LOC.	MVS,COBOL,PL/I,Assembler,other s,PDS,PDSE,Librarian, Panvelet
James Martin & Co.			YES	Impact Analysis	COBOL
"The System Redevelopment Methodology"				Systems redevelopment and reengineering	
800-248-4562					
Keane Federal Systems, Inc. Corp HQ Ten City Square Boston, MA 02129		30	YES	Allied with Viasoft, Inc. "Resolve 2000". Over 300 tech/professionals in MD and VA Offices. Software services,technology migration. Has tool-assisted impact analysis for enviorn. reports, systems inventory, planning and situation assessment.	General
617-241-9200				Conv Planning	
"Resolve 2000"				Imp Planning	

				Offers expertise in wide range of IT services - a full service company	
MASTECH Century Date Change Group		10	YES	Impact Analysis	Cross Platforms, Open Systems,
412-787-9526, 412-787-2100				Conv Planning	Multiple Languages and DBMSs
800-311-1970, Fax 412-787-7450				Code Conv & Data Conv	
				Testing & Implementation	
Micro Focus, Inc.					MVS Application Offloader requires
"Challenge 2000"					the mainframe MVS operating
Palo Alto, California					system and TSO/ISPF; Revolve 3.1
415-856-4161, Fax 415-856-6134					runs under Windows 3.1 or OS/2
http://www.mfltd.co.uk					2.2 or above; COBOL Workbench
Millennium Dynamics, Inc. (MDI)			YES	A toolset designed to allow in	COBOL
"Vantage YR2000"				house century date conversion of	
800-892-7431, 513-369-3041				COBOL systems and files	
Fax 513-369-3077					
OA0 Corp	5	23	YES	Has a Millennium Solution Center to	H/W, Apps S/W, OSs, Automated
7500 Greenway Center Drive				assist Fed agencies with Y2K conv.	tools, IE
Greenbelt, MD 20772				Uses process-oriented methodology	
301-345-0750				and partners with Y2K tool vendors	Business/Scientific/Engineering apps
Fax 301-345-0952				I. Impact Assessment	
with				II. Tools Testing & Ver	
General Services Administration				III. Project Planning	
Tech Services Div				IV. Impl and Testing	
Information Resources				Precompeted contract managed by	
7th & d Sts, SW Room 6109				GSA - No DPA, no CBD, no	
Washington, DC 20407				justification. GSA FISSP contract	
202-708-5732				GSA's Tech Services Div	
Piercom Ltd			YES	Documents/scopes Y2K problems	COBOL
"Year 2000 Impact Analysis"				in legacy systems. Impact	Conversions

Version 1.8 9/10/95				analysis; date field occurrences;	
S/W Reengineering				conversion to C/L; software	
Block2				inventory; assessment of S/W	
Intl Business Centre				quality; metrics; reverse	
National Technological Park				engineering; cost estimating;	
Limerick, Ireland				conversion and testing;	
-335030				implementation	
Fax +353-61-335051					
http://www.commerce.ie/cp/piercom/year2000.html					
PKS Services, Inc.	1+	6	YES	Outsourcing solutions for creating	Cross all platforms.
"Suite 2000"				the Year 2000 test environment.	
908-603-3859 (Mr. Hill)				No tools for C/S or Open Systems.	
				Impact Analysis	
				Conv Planning	
				Code Conv & Data Conv	
				Testing & Implementation	
				<i>The Company has existed for</i>	
				<i>118 years.</i>	
Prince Software, Inc.		20	YES	A S/W services company.	COBOL,BAL,PL/1,JCL,RPG II, other 4GLs, CICS, IMS, DB2
1000C Lake St				Provides "Survey 2000",	
Ramsey, NJ 07446				"Translate 2000",	
800-934-2022				"Simulate 2000", Proj mgmt	
"Portal 2000 Products"				Facility. Y2000 assessment plan, impact analysis and migration plan, detailed conversion plan and more. Pilot conversion S/W analysis. Converts legacy apps for Y2000 compliance. Includes code translation, prog mgmt, inventory anal, testing and imp.	

Quintic Systems, Inc. 3166 Des Plaines Ave Suite 36 Des Plaines , ILL 60018	Several	17	YES	Impact analysis, Code/File Conv, automatically expands to a 4 digit year. S/W converts multiple date formats; expands, contracts or maintains record size; converts record formats; analyzes data for date fields; adjusts file data to simulate	COBOL, SAS, Assembler (BAL), PL/1, Fortran, 4GLs, MVS, VSE/ESA, TANDEM
800-699-1169, 708-699- 1169				future/past dates which verify program accuracy.	
Fax 708-699-1214					
SEEC, Inc. & CBSI				Products support the estimation of	COBOL
"COBOL Analyst"				cost and effort to reengineer COBOL	
(SEEC) 412-682-4991				systems to be Y2K compliant. Will	
(SEEC) Fax 412-682-4958				train your staff to make	
(CBSI) 810-488-2088				conversion.	
(CBSI) Fax 810-488-2089					
Source Recovery Company				Creates source code from machine	SRC recovers COBOL, CICS, DB2,
992 East Freeway Drive				code.	IMS, BMS MAPS, Assembler, any
Suite A					MVS/VSE/VM program
Conyers, GA 30207					
770-785-9801					
Fax 770-760-7316					
SYNTEL		16		A software Solutions Services	IBM mainframes, UNISYS,
Steve Bross				Company that provides technical	Digital, UNIX, C/S
919-233-6200, 919-233- 6485				people to your site or at their	
Fax 919-233-4517				labs. 4000 professionals, time &	
				mtls, turn key and project service	
TRANS Century Data Systems	7			Provides a reliable and	Mainframes to PCs
"TRANS Century Calendar Routines"				comprehensive set of date routines	COBOL, DB2, etc.
415-255-7082, 800-837- 7989				which support Y2K conversion	
Fax, 415-255-4584				efforts.	

Viasoft, Inc.	3		YES	Determine scope, size, level of	MVS operating system, including
"Enterprise 2000"				effort. Identifies project	MVS/XA and MVS/ESA supporting
Phoenix, AZ				reqmnts	products that run in the following
602-952-0050, Fax 602-840-4068				and prepares work plan.	environments: COBOL/370; OS/VS
http://www.viasoft.com				Manages	COBOL; ANSI COBOL; CASE-
				implementation and testing of	generated Cobol; Cobol D, E, and F;
				changes, i.e., plans, manages, and	CICS, DL/1, IDMS, and SQL;
				implements changes.	Workbench
WANG			YES	Impact Analysis	
703-827-3800				Conv Planning	
Fax 703-827-3406				Code Conv & Data Conv	
				Testing & Implementation	
				Compiles a list of business	
				processes from which	
				applications	
				and data bases that support	
				each	
				process are determined.	
Compiled as of 5/31/96					
